

Chuckhole Response Kaizen

City of Indianapolis
Dept. of Public Works in
Collaboration with Eli Lilly

June 23-25, 2008



Kaizen Event Schedule

		- .	347 1 1	
	Monday	Tuesday	Wednesday	
7:00 AM	Prep for Day's Events	Prep for Day's Events	Prep for Day's Events	
7:30 AM	Define/Measure/Analyze	Improve/Implement - Tuning	Sustain Activities	
8:00 AM	Kick-off, Intro's		Risk Analysis/FMEA	
8:30 AM	Charter / Scope	ContinueSolution Development Work	Finish Implementation Items	
9:00 AM	LSS/Kaizen Overview		Tillish implementation tems	
9:30 AM	Data Analysis			
10:00 AM	Process Map			
10:30 AM	Waste Identification		Prepare Presentation	
11:00 AM	Root Cause Analysis		Review/check 30 day list	
11:30 AM		Process Check - Determine	Process Check - Determine	
11.30 AW		Afternoon Plan		
12:00 PM	Lunch		Afternoon Lunch	
	Lunch Process Check - Update Sheets	Afternoon Plan	Afternoon	
12:00 PM	Process Check - Update	Afternoon Plan Lunch Start to Develop Necessary	Afternoon Lunch Follow-up,	
12:00 PM 12:30 PM	Process Check - Update Sheets	Afternoon Plan Lunch Start to Develop Necessary Training Materials / Guides Validate - Compare Results to	Afternoon Lunch Follow-up, Implementation,and Control	
12:00 PM 12:30 PM 1:00 PM	Process Check - Update Sheets Start Brainstorm Process	Afternoon Plan Lunch Start to Develop Necessary Training Materials / Guides Validate - Compare Results to	Afternoon Lunch Follow-up, Implementation,and Control	
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Project Charter



Problem/Goal Statement

- **Problem:** The number of Chuckhole complaints received by MAC has steadily increased since 2003 in all DPW districts with 11,828 in 2007 and 13,378 in the first 5 months of 2008. Median Cycle-time for resolution is 2-3 days with 25% > 5 days. Recent backlog of ~2,300 complaints. Unresolved CHK repairs cause an estimated \$XX yearly in property damage and expose the City to liability claims (\$ in 2007).
- Goal: Target time to resolve CHK SR < or = 48 hrs
- Scope: Chuckhole complaints received from citizens in MAC to work order closed

Team

- Sponsors: Michael Huber, Sarah Taylor
- Process Owner: Todd Durnil
- Carnie Sillery, Dennis Tiller
- ◆ Kenneth Stringer, Damon Johnson, David Singer
- Jon Wilson, Steve Holder, Mike Dale
- Brenda Woodson, Nicole Randol
- Steven Quick, Keith Fey
- Master Black Belt: Gary Hadley

Financial Impact

 Financial impact of project determined after Kaizen event and piloting of new solutions

Milestone Review Schedule

Milestone

Pre-Kaizen: May 30-Jun 20, 2008

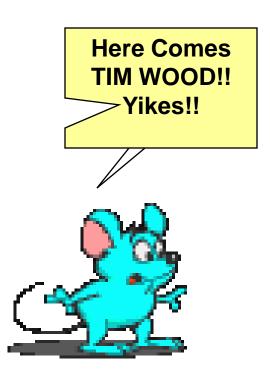
Kaizen Event: Week of June 23, 2008

Commissioning: 30-60-90 day reviews

Validate:

We will strive to eliminate Waste during the Kaizen Process





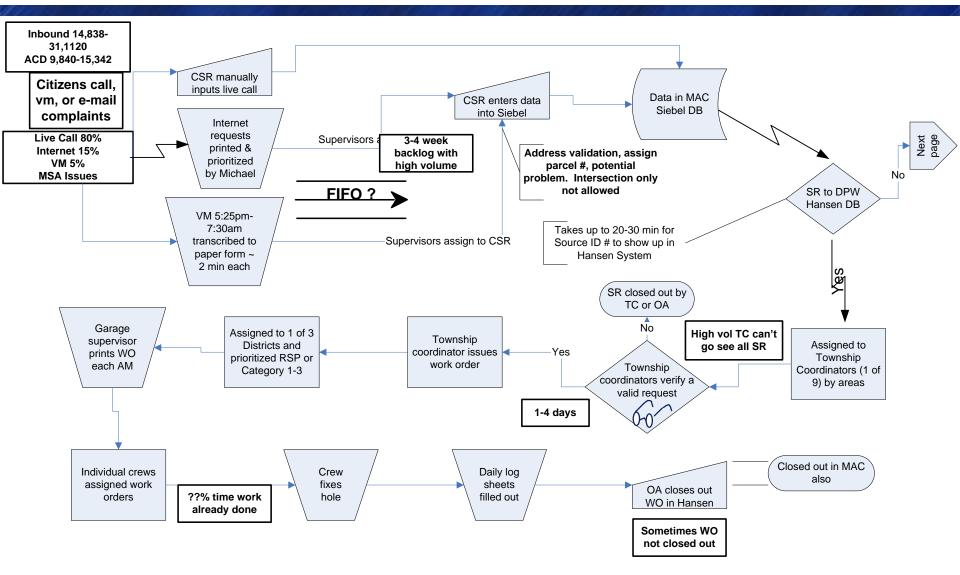
7 Types of Waste:

Transportation
Inventory
Motion

Waiting
Overproduction
Over processing
Defects



"As is" Process Flow





Operational Definitions

- ◆ Y Continuous data: Cycle-time of chuckhole repair in calendar days from day complaint request left by constituent (web, VM, or call) to day repair completed
- ◆ X Subgroups values or X-factor groupings for project data collection
 - Priority level (levels as currently defined)
 - Type of Mix used (hot, cold, special cold)
 - Tonnage of "mix"
 - Crew (District 1,2,or 3; specific crew leader)
 - Chuckhole and pothole are considered synonymous terms



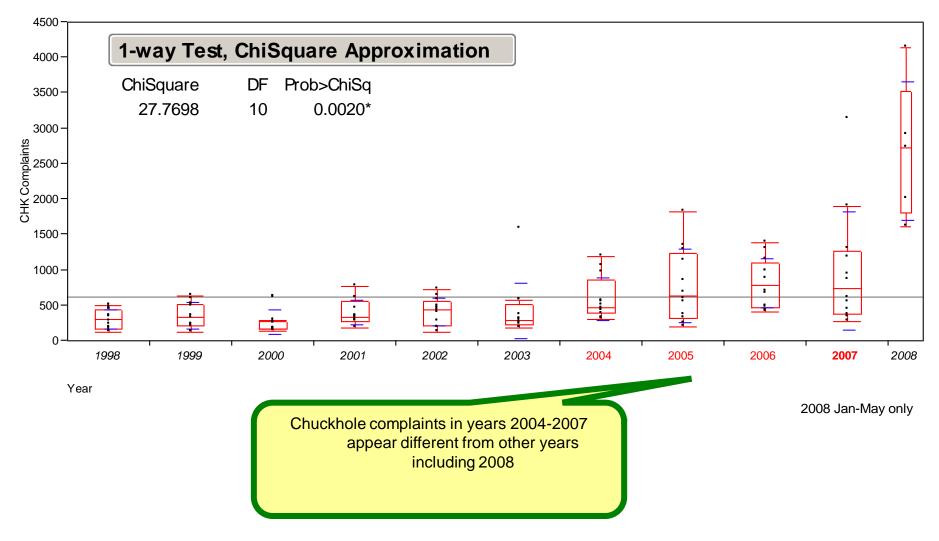
Priority Operational Definitions

- RSP
- Priority 1
- Priority 2
- Priority 3

 Confusion exists among priorities and RSP.
 Inconsistent application

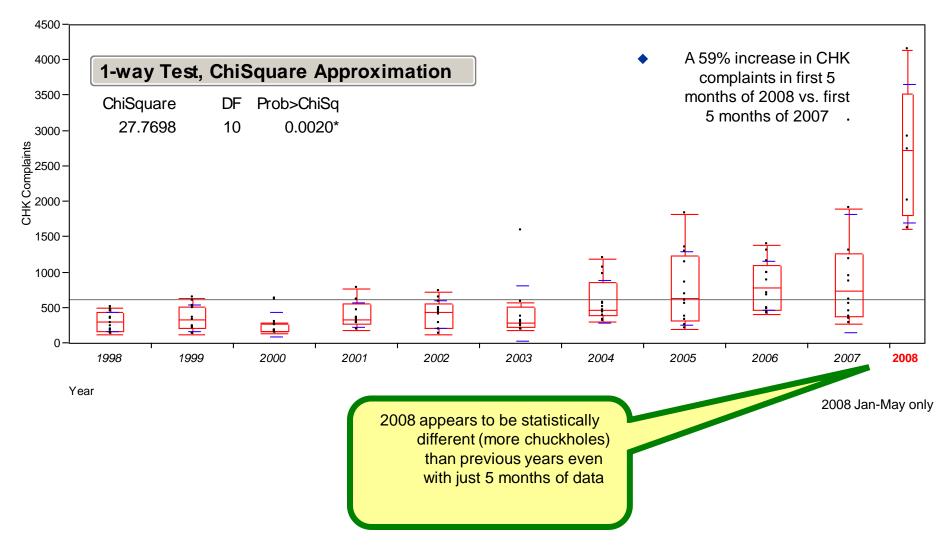


Chuckhole Complaints by Year





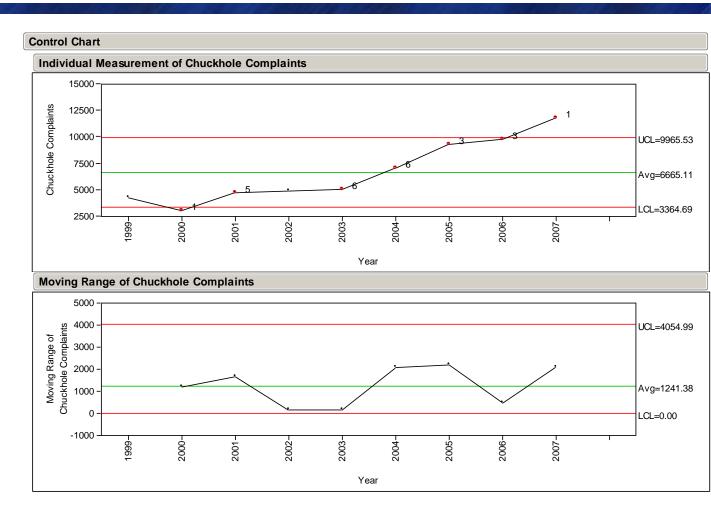
Chuckhole Complaints by Year



Baseline Data -Control Chart: Chuckhole Complaints



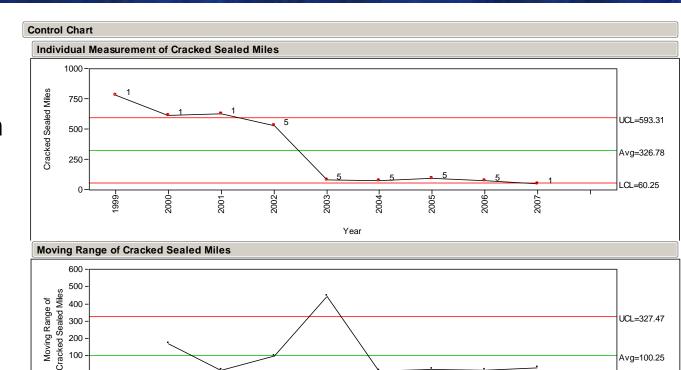
- Complaints
 are increasing
 and out of
 control.
 Change in
 process
 between
 2003-2004
- All available
 (N=9) data
 points
 collected with
 zero
 subgroups,
 I&MR control
 chart selected



Baseline Data -Control Chart: Cracked Sealed Miles



- Significant change in process between 2002 and 2003 continuing to 2007
- N=9 data points collected with zero subgroups, thus the I&MR control chart selected



2003

Year

Reduction in Cracked Sealed Miles is likely one root cause for increase in Chuckholes

300

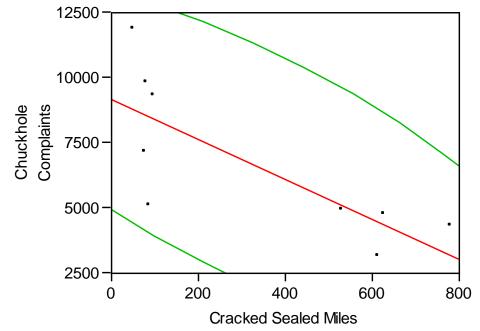
-100

Avg=100.25 LCL=0.00

Baseline Data –Regression Analysis: Cracked Sealed Miles vs. Chuckhole Complaints



- Significant negative correlation between **Cracked Sealed Miles** and Chuckhole Complaints
- N=9 data points collected. Variation in **Cracked Sealed Miles** accounts for about 59% of the variation in Chuckhole Complaints.
- Cause and Effect though can not be established



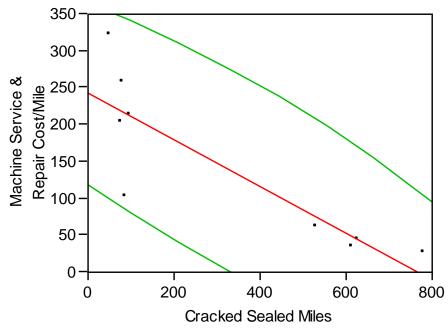
Chuckhole Complaints = 9152.0945 - 7.610626 Cracked Sealed Miles						
Correlation						
Variable	Mean	Std Dev Correlation	Signif. Prob	Number		
Cracked Sealed Miles	326.7778	302.2709 -0.76997	0.0152*	9		
Chuckhole Complaints	6665.111	2987.74				
RSquare		0.592854				
RSquare Adj		0.53469				
Root Mean Squa	are Error	2038.045				
Mean of Respon	nse	6665.111				
Observations (d	or Sum W	gts) 9	8/28/2009	1:25 PM		

Baseline Data –Regression Analysis: Cracked Sealed Miles vs. Machine Service & Repair Costs/Mile



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- Significant negative correlation between Cracked Sealed Miles and Machine Service & Repair Costs/Mile
- N=9 data points collected. Variation in Cracked Sealed Miles accounts for about 74% of the variation in Machine Service & Repair Costs/Mile.
- Cause and Effect though can not be established



Machine Service & Repair Cost/Mile = 242.23338 - 0.3150222 Cracked

Sealed Miles

Correlation

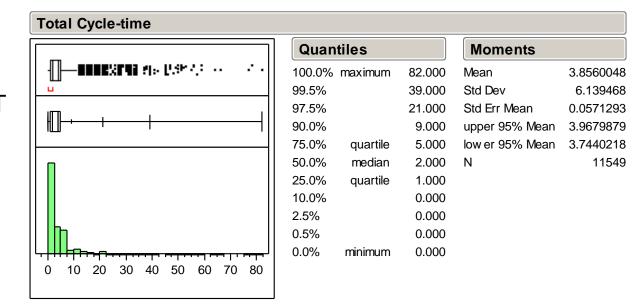
Variable Mean Std Dev Correlation Signif. Prob Number Cracked Sealed Miles 326.7778 302.2709 -0.8617 0.0028* Sealed Miles 139.2911 110.5052

Summary of Fit	
RSquare	0.742522
RSquare Adj	0.70574
Root Mean Square Error	59.9444
Mean of Response	139.2911
Observations (or Sum Wgts)	9

Baseline Data -Control Chart Chuckhole Complaint Resolution Cycle-time



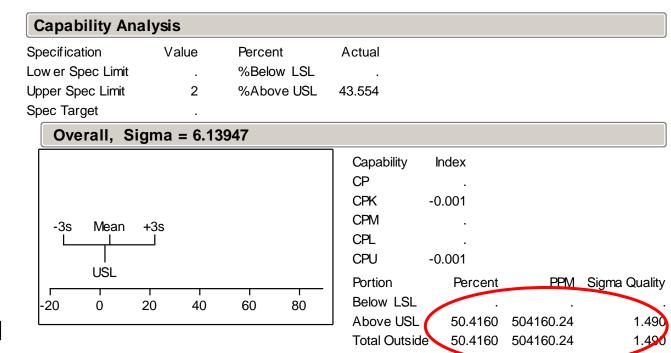
- The current baseline Chuckhole resolution process has Median CT of ~2 days. With 25%
 5 days
- 11549 useable data points collected by DPW (Jan-Jun 2008). CT is in calendar days from time SR opened until closed.
- ◆ CAUTION: Some SR may take weeks to be entered into the system and this time is not counted. WO closed out on same counted as zero time





Baseline Process Capability

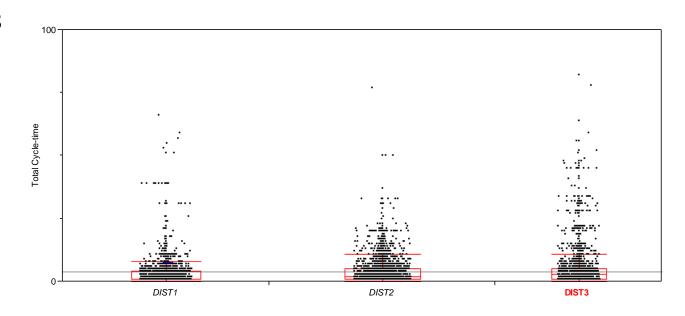
- ◆11549 data points collected between Jan 1 and Jun 10, 2008
- ◆ Caution: IR chart indicates process is *not* in control. Cpk is -0.001 indicating that the process is not very capable.
- ◆With an overall PPM of 504,160 defects per million opportunities, the current process has a Sigma Quality Level of 1.49 or a 49.6% yield





Cycle-time by District Analysis

- ◆11549 data points collected between Jan 1 and Jun 10, 2008
- ◆ All districts are statistically different from each other.
- ◆Median CT
 - Dist 1= 1 day
 - Dist 2= 2 days
 - Dist 3= 3 days



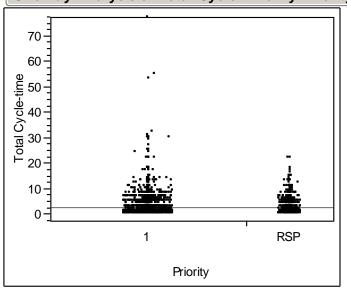
1-way Test, ChiSquare Approximation

ChiSquare DF Prob>ChiSq 210.9045 2 <.0001*





Oneway Analysis of Total Cycle-time By Priority



Excluded Rows 10

Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

 Level
 Count
 Score Sum
 Score Mean
 (Mean-Mean0)/Std0

 1
 2319
 3837490
 1654.80
 -1.947

 RSP
 1032
 1778787
 1723.63
 1.947

2-Sample Test, Normal Approximation

S Z Prob>|Z| 1778786.5 1.94688 0.0515

1-way Test, ChiSquare Approximation

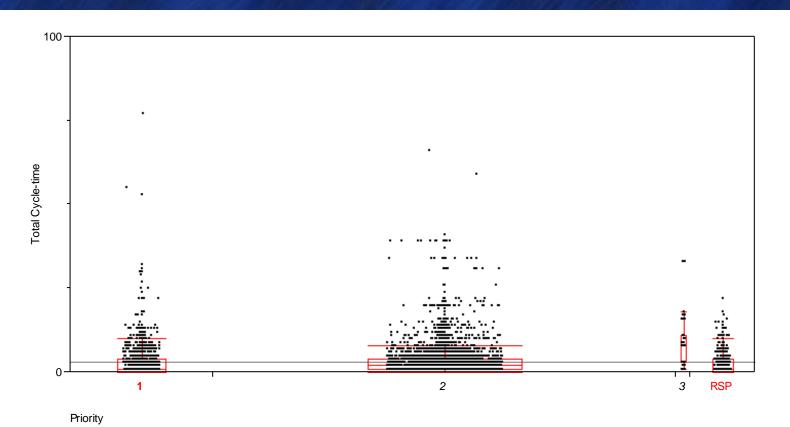
ChiSquare DF Prob>ChiSq 3.7904 1 0.0515



 RSP CT does appear to be faster than Priority 1



CHK Priority Cycle-time

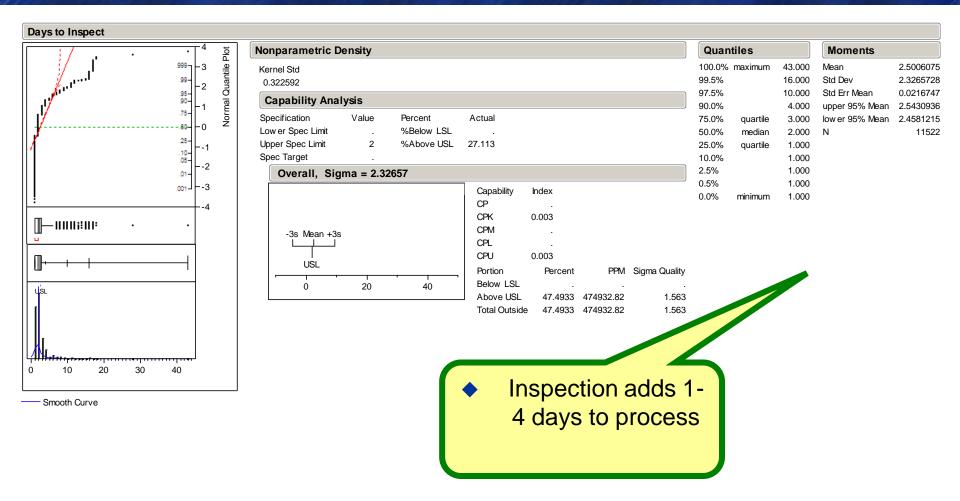


1-way Test, ChiSquare Approximation

ChiSquare DF Prob>ChiSq 141.5024 3 <.0001* RSP and Priority 1 CT is faster than Priority 2 and 3

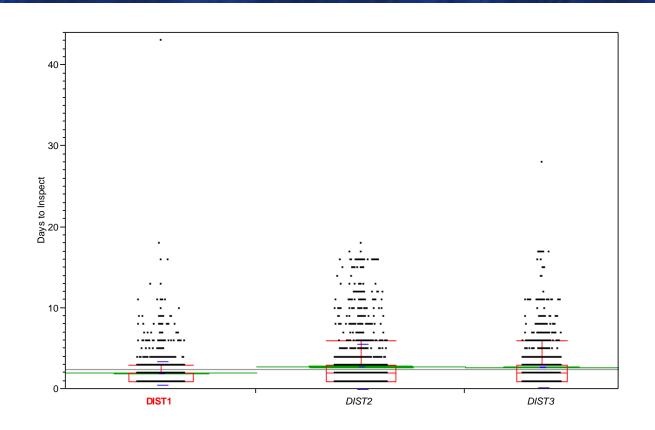












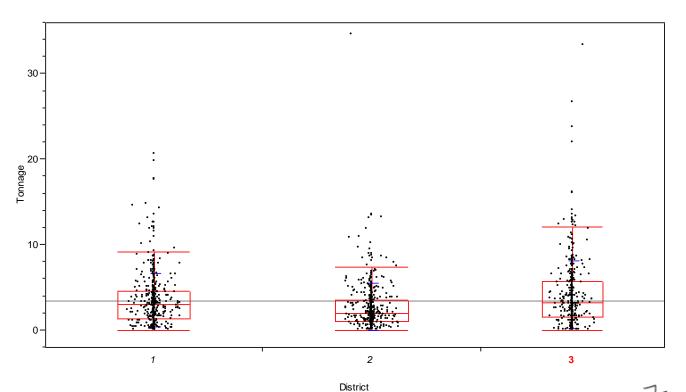
 District 1 time to inspect is shorter than Districts 2 and 3

1-way Test, ChiSquare Approximation

ChiSquare DF Prob>ChiSq 141.0411 2 <.0001*







 All Districts are statistically different from each other in tonnage. District 3 delivered the most followed by 1 and then 2

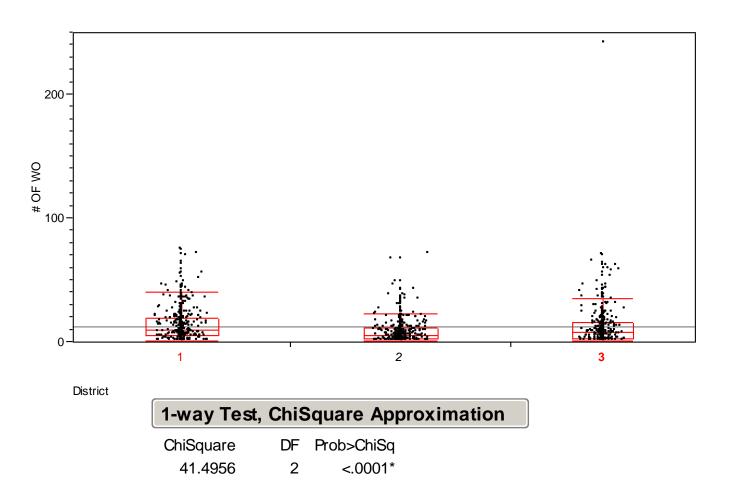
1-way Test, ChiSquare Approximation

ChiSquare DF Prob>ChiSq 45.2500 2 <.0001*





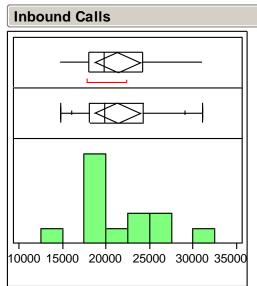
Number of Work Orders by District



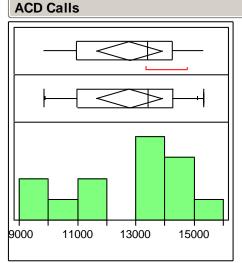
Districts 1 and 3
 WO are
 statistically
 higher than
 District 2 and
 are different
 from each other
 District 1 has
 the most WO



MAC Call Activity: May 2007-May 2008



Quantiles **Moments** 100.0% maximum 31120 Mean 21324.923 99.5% 31120 Std Dev 4370.0241 97.5% 31120 Std Err Mean 1212.0266 90.0% 29005 upper 95% Mean 23965.702 24260 low er 95% Mean 18684.144 75.0% quartile 50.0% median 19876 Ν 13 25.0% quartile 18120 10.0% 16011 2.5% 14838 0.5% 14838 0.0% 14838 minimum

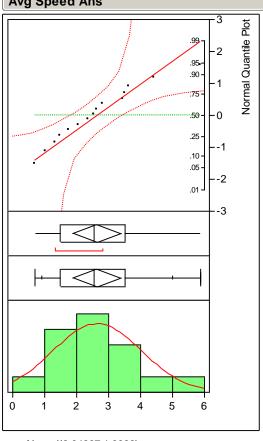


Quantiles			Moments	
100.0%	maximum	15342	Mean	12790.231
99.5%		15342	Std Dev	1882.2109
97.5%		15342	Std Err Mean	522.03138
90.0%		15115	upper 95% Mean	13927.639
75.0%	quartile	14270	low er 95% Mean	11652.822
50.0%	median	13405	N	13
25.0%	quartile	10978		
10.0%		9884		
2.5%		9840		
0.5%		9840		
0.0%	minimum	9840		



Distribution Avg. Speed Answer

Avg Speed Ans



Quan	tiles	
100.0%	maximum	5.8700
99.5%		5.8700
97.5%		5.8700
90.0%		5.0060
75.0%	quartile	3.5200
50.0%	median	2.5500
25.0%	quartile	1.4700
10.0%		0.8980
2.5%		0.7000
0.5%		0.7000
0.0%	minimum	0.7000

Moments	
Mean	2.6426667
Std Dev	1.382200
Std Err Mean	0.3568826
upper 95% Mean	3.4081038
low er 95% Mean	1.8772296
N	15

Fitted Normal

Parameter Estimates

Upper 95% Parameter Estimate Low er 95% 3.4081038 Location µ 2.6426667 1.8772296 Dispersion σ 1.3822005 1.0119457 2.179867

Quantiles: Uncentered and Unscaled

Percentile Quantile 1.000000 13.61920

Goodness-of-Fit Test

Shapiro-Wilk W Test

W Prob<W 0.956161 0.6260

Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Normal(2.64267,1.3822)

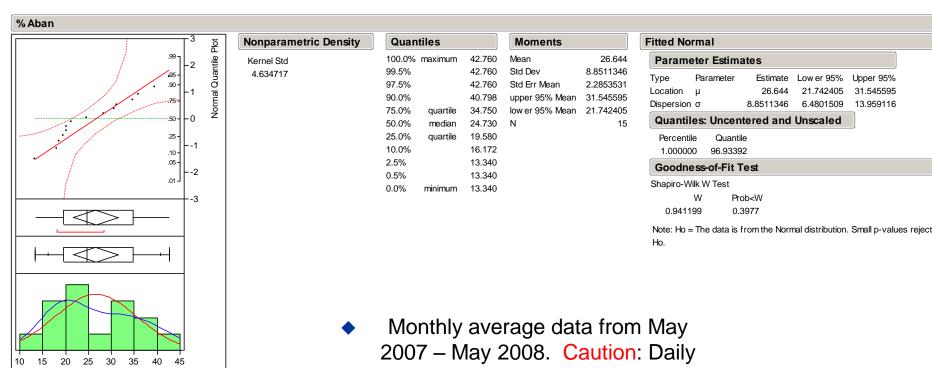


Upper 95%

31.545595

13.959116

Distribution of % Abandon Calls



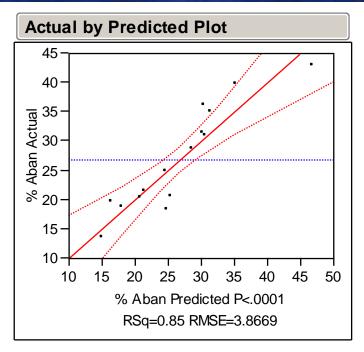
abandon rates may range higher than indicated max of 42.76%

Normal(26.644,8.85113)

Smooth Curve



% Abandon Calls Prediction Model



RSquare 0.850032 RSquare Adj 0.809132 Root Mean Square Error 3.866924 Mean of Response 26.644 Observations (or Sum Wgts) 15

- Prediction Equation: % Abandon = 0.0028825 (Inbound calls) 0.005122 (ACD Calls) + 12.361413 (Avg ACD Time)
 - If CHK complaints were not taken by the MAC, the predicted abandon rate would average ~5%

Parameter Estimates

Analysis of Variance							
Source	DF	Sum of Squares	Mean Square	F Ratio			
Model	3	932.3121	310.771	20.7830			
Error	11	164.4841	14.953	Prob > F			
C. Total	14	1096.7962		<.0001*			

Term	Estimate	Std Error	t Ratio	Prob> t	VIF
Intercept	-3.019143	19.70441	-0.15	0.8810	
Inbound Calls	0.0028825	0.000484	5.96	<.0001*	9.1779615
ACD Calls	-0.005122	0.000801	-6.40	<.0001*	7.449735
Avg ACD Time	12.361413	8.004853	1.54	0.1508	1.7652347



Identified Root Causes

- Wait time at hot mix plants (also travel to and from plant)
- Wait time pre-planning the days work at garage
- Work orders sometimes are not closed when completed
- Crew leaders and crew stop in time to complete daily paperwork
- Left open orders that don't get completed or closed
- Large queues at MAC , delays in VM and e-mail SR
- Siebel to Hansen handoff issues with location of CHK
- Inspection delay at Customer Service step (TC)
- Location of SR is inaccurate or not specific



Identified Root Causes

- WO not grouped in close geographic area (>transportation, supervisor not familiar, poor planning and no standard process)
- Crew set-up reduction problems. Called off site to do emergency WO (lack of supervisor discipline, poor planning)
- ARD Duplicate WO (linked to WO not closed)
- Inspectors can't see what's being worked on real time (poor communication, lack of transparency)
- Crews start day with less than full of mix (afraid to get stuck with hot mix, poor planning and accountability, lack of confidence that have a full load of work for day)



Identified Root Causes

- No clear single point of accountability for overall process
- No clear performance measure or expectation
- Maintenance issues with equipment cause delays
- No standardized process for planning or fulfillment of WO
- Inadequate work planning and routing by management (training, no standardized process, span of control)
- Too much focus on the individual work order



Prioritized Root Causes

- Inadequate work planning and routing by management (training, no standardized process, poor management of queue with operational definition issues on priority, span of control issues)
 - Linked to WO not grouped in close geographic area (>transportation, supervisor not familiar, poor planning and no standard process)
- Duplicate work orders and left open work orders
- No single point of accountability with clear performance metrics
- Crews pick up less than full load of hot mix
- Queue buildup at MAC, Inspection by Township coordinator, and at Districts



Solution Development

	Baseline	Outlaw lower tech	Outlaw high tech	Miracles	Importance Rating
Cost to Implement	S	S			23
Time to implement	S	-			7
Positive Impact on CT	S	+	+	+	46
Addresses Root Causes	S	S	+	+	27
Total	0	0	-2	-2	
Weighted Total	0	39	13	13	

Outlaw lower tech

Voice mail goes away. Directs people to the web portal. Web portal has form to fill out. Fairly signifigant staff time. Already own tool. Portal directs to garage. Supervisors will review SRs and create WOs. Emergencies go to rapid response. Rapid response does all of segment.

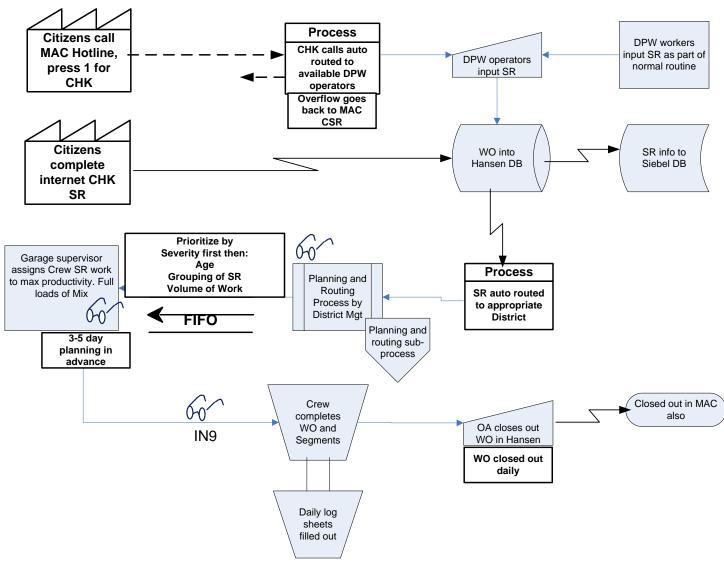
Miracles

people at garages. E-mail direct to Hanson that would feed Siebel. Manager of district will drive the district quarterly. Catch problems before people call them in. All service requests are

 Solution ideas were generated and evaluated against weighted criteria using AHP and Pugh Matrix.
 Best ideas synthesized into overall solution

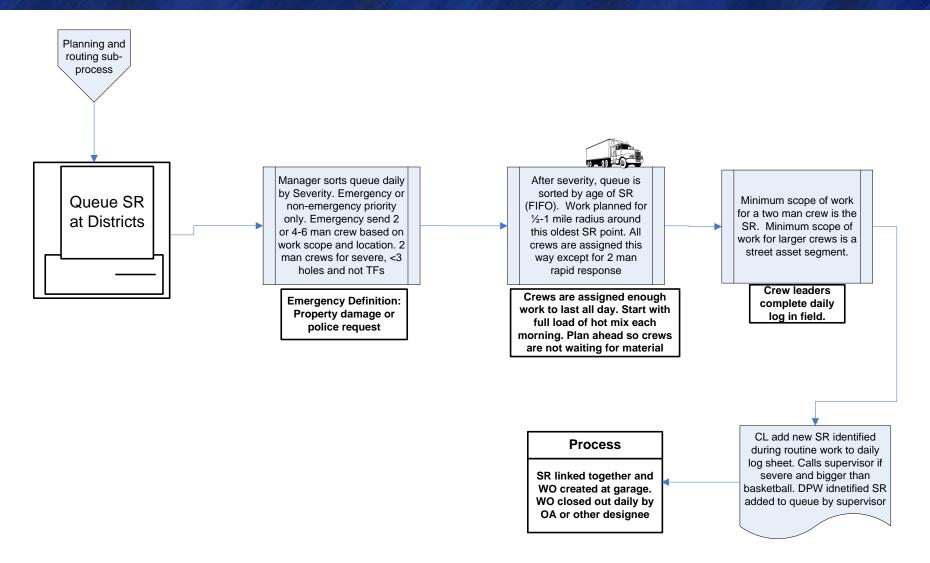


"To Be" Process Map





Work Planning and Routing Sub-Process





Summary of Process Improvements

- Stop taking VM Service Requests at MAC (Time savings)
- Enhance website to enable direct input of SR into Hansen DB (Time savings avoiding manual re-entry of SR)
- ◆ Callers to MAC auto routed to customer service reps at DPW (Predict dropped calls at MAC decrease to ~5%)
- Eliminate step of inspection (1-4 days) and WO creation by Township Coordinators
- SR automatically routed to District Level
- Standardized process for planning, routing, and prioritization by District garage management
- Performance metrics with clear accountability



Ongoing Process Performance Metrics

- The following key process performance metrics will be monitored on an ongoing basis:
 - Performance Metric 1: CHK SR process cycle-time
 - Operational Definition: CHK SR process cycle-time from date received to date closed (calendar days) USL 2 days
 - Data Collection: Carnie Sillery, Dennis Tiller
 - Performance Review: Indy Stat Review, District Management,
 DPW Director level
 - Performance Metric 2: Public CHK Service Requests
 - Operational Definition: Count volume of all CHK SR generated by anyone other than DPW personnel (low volume goal)
 - Data Collection: Carnie Sillery, Dennis Tiller
 - Performance Review: Indy Stat Review, District Management,
 DPW Director level

Additional key input variables will be tracked per control plan

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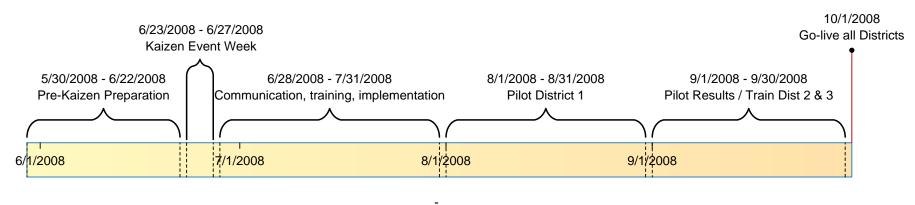


Implementation Plan

Item	Description	RACI Assignments	Schedule
DPW chuckhole hotline	Determine what is needed to implement the chuckhole hotline.	Carnie /Todd	
Determine call takers		Carnie / Todd	9/1/2008
Activate line(s)		Nichole/Brenda	1/1/2009
Make changes to MAC front end		Brenda	1/1/2009
Verify equipment and create vector		Nichole	
Addess validation by SR type	Change addesss validation so that Siebel and Hansen communicate addresses the same way	Nichole	
Pothole web portal	Automate input from web to Hansen	Nichole	
Improve data entry in from web	Create script to input data directly in to Hansen	Nichole	
Auto creation of maps for SR planning		Nichole	
Auto assign only by geographic area	Assign to district by location	Nichole	7/24/2008
Create detailed description of the new process.		Dennis/Ernie/Consult w/ everyone on team	8/1/2008
Memo explaing new proces s from beginning to end	Executive summary	Todd	7/9/2008
Train people on process (Crew leaders, supervisors, managers) for pilot		Carnie	8/1/2008
Pilot Process at First Garage		Michael Dale	8/1/2008
Roll out to second and third garage		Art Thomas and Ron Rhoton	10/1/2008
Train people on process (Crew leaders, supervisors, managers) for implementation		Carnie/Todd	9/25/2008
Presentations of new process to stakeholders.		Todd, Steve & Mike	7/15/2008
Identify backups for OAs		Garage Managers	7/15/2008







5/30/2008



Communication Plan

Template: Project communication Plan

Project Name:

CHK Kaizen

Objective	Key Message	Audience	Timing	Media/Activity	Owner
Inform and gain buy- in/support	Implementation update, summary of improvements, and key performance metrics	IndyStat Group including Mayor	Monthly	Oral updates and summary of improvement activities	Todd Durnil, Sarah Taylor, and Michael Huber
Gain support. Dampen rumor mill	Summary of project and what it means to DPW empoyees	DPW non management personnel	Within 2 weeks of Kaizen	Memo out to DPW workers	Steve Quick, Todd Durnil or designees
Gain support and prepare for implementation. Coordinate with training plan	Project findings and implementation plans	District 1,2,3 managers, supervisors,and crew leaders	Before 7-15-08	Presentation and Q/A	Steve Quick, Todd Durnil or designees
Let public know this Administration has heard the complaints and has taken action to fix the problems	Significant improvements have been made to the CHK resolution process	Citizens of Marion	After pilot complete and results of process improvements confirmed	TBD	Mayor, Dir. Constituent Services and Todd Durnil



Pilot Plan: Chuckhole Resolution Kaizen

Pilot Test	Description	Success Criteria	Team	Schedule
District 1 Garage	Train personnel and run complete new process.	CT <48h Evidence that the priority planning and routing being conducted per new process Proper use of 2 man and 6 man crews DPW personnel submitting SR Daily close-out of WO	•Mike and his supervisor, selected crew leaders, OA, crew team members.	Start Aug 1, run for one month.

Verify Pilot Results: Key questions will be addressed in Pilot



- Did pilot have anticipated results? (Answer quantitatively and graphically)
- Was the plan for conducting the pilot effective?
- What improvements can we make to the solution?
- Can the solution be implemented "as-is"? Should it be?
- Can the solution remain in place at the pilot location?
- What lessons learned and best practices can we apply during full-scale solution implementation?
- Did the solution achieve the required design goals?





Process RACI Chart

R = Responsible/Resource – *The person who performs the action/task.*

A = Accountable – The person who is held accountable that the action/task is completed.

C = Consulted – The person(s) who is consulted before performing the action/task.

I = Informed – *The person(s) who is informed after performing the action/task.*

Step	Action/Task	Responsible	Accountable	Consulted	Informed
				Brenda, Nichole,	
1	Managing phone calls into SRs	Operators	Jean	Carnie	
2	Autorouting of SRs		Carnie		
3	Planning and Routing	Supervisors	Garage Managers	Todd, Dennis	Todd
4	Inspection and capture for unreported potholes	Anyone in a vehicle	Garage Manager		Todd
5	Filling potholes	Assigned crew	Crew Leader		Supervisor
6	Close daily log in field	Crew Leader	Supervisor		
7	Lump SRs into WOs	OA/Supervisor	Garage Manager		Todd
8	Close out WO's by end of day.	OA/Supervisor	Garage Manager		Todd
9					
10					





		Six Sigma	Process	Control Plan	Page: 1 of 1 Document No:						
Process Name	e: CHK Complaint Resolution		Prepared by:	Tod Durnil	Page:1of1						
Proccess Own	neı Todd Durnil	Int/Ext	Approved by:		Document No:						
Location:	DPW Operations		Approved by:		Revision Date: 6/25/2008						
Area:	All Districts		Approved by:		Supercedes:						

Sub Process	Sub Process Step			Specification Characteristic	Specification/ Requirement USL LSL	Measurement Method	Sample Size	Frequency	Who Measures	Where Recorded	Decision Rule/ Corrective Action
Pick Up Hot Mix	Tonnage load amount	RFOV	KFIV	Full load hot mix = 3.5 tons or >	LSL = 3.5 tons	Mix plant tonnage receipts. Control charts and capability analysis by district	NA	Weekly roll- up	Dennis Tiller QA	Operations IMS Data Records	Significant departures from expected pick- up quantities should be investigated by management. Adjustments for concrete (always less) vs asphalt
Overall Cycle- time for SR				From time SR comes into DPW to SR/WO closed out	days	Control charts and capability analysis by district	NA	Weekly roll- up	Dennis Tiller QA	Operations IMS Data Records	Significant departures from expected cycle-time should be investigated. Looking for median time of 2 days with little variation. 80% or > yield
Customer SR				Counts of customer generated CHK SR		Average and control chart by district	NA	Weekly roll- up	Dennis Tiller QA	Operations IMS Data Records	Customer SR should decrease over time if routine preventive maintance strategy is implemented.
DPW SR				Counts of DPW generated SR for CHK		Average and control chart by district	NA	Weekly roll- up	Dennis Tiller QA	Operations IMS Data Records	DPW SR should be at steady rate across districts
SR Queue				Total SR Queue count at end of each week		Manager report by district	NA	Weekly roll- up	Dennis Tiller QA	Operations IMS Data Records	Large queue build-up must have management plan to address
ARD				Already done count	USL= 3% SR	Manager reports counts of ARD instances by district	NA	Weekly roll- up	Dennis Tiller QA	Operations IMS Data Records	Reports of crews encountering ARD shoud be declining over time



Risk Considerations

- Loss of momentum on project
- Current technology may prove too difficult to use
- Delays in technology upgrades
- Lack of support or buy-in for solutions by key stakeholders
- Availability of Office Assistants to take calls
- Poor compliance and accountability



Multi-Generational Ideas

- ◆ 5S District Garages and Equipment
- ◆ Fleet Maintenance: Equipment readiness (uptime) project
- CHK Filling Standardized Process (quality focus)
- Evaluation of various patch mixes (DOE)